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PHYSIOGRAPHIC NOTES.

BY

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FRESH-WATER DEPOSITS OF THE WEST.—In recent papers (see, for example, *Proc. Amer. Acad. Arts and Sciences*, xxxv, 1900, 345–373) Prof. Davis has raised a question concerning the geology of the West which has attracted a great deal of attention. It is a well-known fact that throughout the West there are extensive deposits of sand and gravel which have been almost universally ascribed to lacustrine origin. Upon the basis of these deposits the recent history of the mountainous West has been interpreted somewhat as follows: First, broad seas with projecting mountain spurs; second, with the growth of the mountains, a narrowing of the seas and a closing of the inlets, transforming the seas to estuaries, and later to lakes; finally, with the continued growth of the mountains and the dragging of rock fragments down the mountain slopes, the lake basins have been destroyed. During this period the mountainous West was a region of numerous and extensive lakes.

The purpose of Prof. Davis's paper is to question the lake origin of the deposits as a universal explanation and to suggest as an alternative hypothesis that a fluviatile origin will apply to certain regions. This explanation has certainly been in the minds of some geologists, as, for instance, in explanation of the peculiar and very extensive beds which fill the valley of California; but it is to Prof. Davis that we owe the first clear and specific statement of this point of view.

After a summary of the published statements concerning these supposed Tertiary lakes, Prof. Davis considers the characteristics of lake deposits and discusses the characteristics of fluviatile and other deposits, and he also considers special instances of accumulations in the West which have been ascribed to lake origin. He declares that the object of his papers is to promote consideration rather than to announce conclusions. There seems little doubt that in studies of the West the lacustrine origin has been assumed in many cases without critical consideration of other possible explanations, particularly that of fluviatile origin; and it is by no means impossible that a careful analysis of the facts in each instance will show that at least some of the so-called lake beds have in real-

ity been accumulated in basins by the washing of river and rain waters and without the intervention of lakes.

GLACIAL EROSION.—The tide of opinion seems to be setting toward a belief in the effectiveness of glacial erosion where local conditions favor. That is to say, after the revulsion following the extreme views upon the subject held by early geologists, students of the subject are now taking the middle ground. This change of opinion is very well illustrated by two recent papers from the pen of Prof. Davis. (*Appalachia*, ix, March, 1900, 136-156; *Proc. Boston Soc. Nat. Hist.*, xxix, 1900, 273-322.) Eighteen years ago a paper published by Prof. Davis took a rather strong stand against the extreme view of great glacial erosion; but he now says: "In a retrospect from the present time, it seems to me as if one of the causes that led to my conservative position was the extreme exaggeration of some glacialists, who found in glacial erosion a destructive agency competent to accomplish any desired amount of denudation—an opinion from which I recoiled too far."

During recent travels in Europe Prof. Davis has seen evidence in various places that ice has operated locally to a marked extent, and it is a description of these observations which constitutes the main basis for his papers. His most important evidence of glacial erosion is that which is offered by certain valleys down which ice has moved with rapidity, lowering the bottoms of the main valleys below the floors of the tributaries. This condition he calls "over-deepened main valleys and hanging lateral valleys." One of the most typical cases which he has seen is that of the Ticino valley in the Alps; but he describes others in Norway and refers to other instances.

The paper in the Proceedings of the Boston Society closes with a review of previous writings on the same subject, and this review of the literature is interesting in that it shows to what extent glacial geologists are returning to the belief that ice can erode very markedly where conditions are favorable. To the writer of this note Prof. Davis' conclusions are of considerable interest, since the basis for his conclusions, resulting from his European studies, is almost exactly the same as that which I presented in 1894 in explanation of the Cayuga Lake Valley. (*Bull. Geol. Soc. Amer.*, v. 1894, 339-356.)

THE ILLINOIS GLACIAL LOBE.—For many years, under the direction of Prof. Chamberlin, much detailed work has been done upon the glacial geology of portions of the middle West. Among the

assistants of Prof. Chamberlin the one who has done the most continuous work is Frank Leverett, and from him glacial geologists expect important results. He has already published a number of papers, but the first extensive work which has appeared from his pen is his recently published Monograph on the Glacial Lobe of Illinois. (*Monograph U. S. Geol. Survey*, xxxviii, 1899.)

The ice which covered this portion of the country was supplied from the northeast, and, according to Leverett, its history has been very complex. Much of the Monograph is devoted to a description and consideration of the several till beds and the intermediate weathered zones, together with a description of the moraines and other glacial features. It is impossible to abstract so long a monograph in the space that is available here; but one of the striking portions of the work is the chapter devoted to the question of the depth of the drift in Illinois—a State that is well calculated to furnish information on this point because of the large number of wells and borings. Leverett has carefully gathered the information which these furnish, and from his study concludes that the average depth of the drift in Illinois is from 100–130 feet.

The chapter devoted to the study of the glacial Lake Chicago is also of especial interest. This lake, which overflowed into the Des Plaines and thence into the Illinois river, covered the site of the city of Chicago, and the beaches marking the various levels are still to be seen, some of them within the very city itself. There is also a portion of the Monograph devoted to a consideration of the changes in the rivers as a result of the glacial invasion. It is just such studies as this which glacial geology needs to serve as a basis for explanation of phenomena which, though obscurely understood, nevertheless have no lack of hypotheses in explanation.

THE GLACIAL GRAVELS OF MAINE.—One of the most striking features in the glacial geology of Maine is the presence of extensive beds and ridges of gravel. The latter, known as osars or eskers, though locally called by other names, such as hogback, are to be frequently seen in driving across the country. In fact, many of the roads run along the crests of these eskers for a considerable distance. They vary in height from three feet to over one hundred; some of them are in the open country, but a great many are in the woods, and, in consequence, are very difficult to study.

Attracted by the remarkably clear development of these forms, Stone undertook to work out the problems which they presented, and completed his work in 1889, although the results were not pub-

lished by the Geological Survey until ten years later. (*Monograph U. S. Geol. Survey*, xxxix, 1899.) This monograph consists of descriptions of the general features of the glacial geology of Maine and a detailed description of the extensive gravel deposits, particularly the eskers. In Maine these are found to be confined to the river valleys, in the main stretching continuously for long distances, though often broken by gaps of considerable size. The several esker systems are named and the deposits mapped, and the monograph closes with a discussion and a classification of the features of individual deposits, being particularly detailed on the subject of eskers. It is to such painstaking studies that we must look in the future for the basis upon which to generalize concerning the conditions during the Ice Age. Besides the credit which belongs to one who gives so much time to extensive local studies, additional credit is due for intelligent work in the midst of such difficulties as those which must have been met with by Stone during his studies in the wooded portions of Maine.

GEOLOGY OF NARRAGANSETT BASIN.—From a number of stand-points the region about the shores of Narragansett Bay is of marked interest, and the publication of a monograph by Shaler, Woodworth & Foerste (*Monograph U. S. Geol. Survey*, xxxiii, 1899) furnishes an answer to many of the questions that have been raised concerning the geological history of this rather remarkable region. In a deep basin of Carboniferous time there were accumulated a succession of beds similar to those of other coal regions. Then, succeeding the period of deposition, there came a time of uplift, doubtless connected with the Appalachian revolution, which succeeded in producing very much more marked effects of metamorphism upon the coal measures of this section than was the case in the Appalachian coal-fields. The mountain-folding which has been responsible for the metamorphism has consisted not merely of rock-folding, but of much faulting, and the geological structure of the region has been still further complicated by the intrusion of masses of igneous rock. The subsequent erosion of this complex of rock material has resulted in the formation of the present basin, depressed between massive crystalline rocks on either side, and, through recent sinking of the land, transformed at the lower margin to an arm of the sea.